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(54) METALLIC MOLD CASTING METHOD OF HEAT RESISTANT IRON BASE PARTS

(57)Abstract:
PROBLEM TO BE SOLVED: To cast heat resistant iron base parts provided with excellent high temp. strength of a spheroidal graphite cast iron by pouring molten iron in the specified temp. range into a copper alloy-made metallic mold held to a specified temp. obtaining a casting and heating the obtd. casting at the specified temp. range for the specified time.
SOLUTION: In the case of casting the heat resistant iron base parts into the metallic mold by pouring the molten spheroidized graphite cast iron into the metallic mold to obtain the casting, the molten metal at 1,380-1,440°C is poured into the copper alloy metallic mold held at 80-300°C to obtain the casting, and the casting obtd. in such a way, is heated at 900-940°C for 30-60 min. When the molten spheroidized graphite cast iron is poured into the metallic mold under these temp. conditions, since the metallic mold cools the molten metal at quicker speed in comparison with that of a sand mold, the crystallized spheroidal graphite is made to fine and ferrite structure the casting made to sheets is made to close to expect the improvement of the high temp. strength. Cementite Fe3C contained in chilling structure is decomposed into the ferrite and carbon by executing the heating treatment, the high temp. strength, particularly, tensile strength is improved.

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CLAIMS

[Claim(s)]
[Claim 1] The metal-mold-casting method of heat-resistant iron system components which are the metal-mold-casting methods of heat-resistant iron system components of carrying out teeming of the molten metal of spheroidal graphite cast iron to metal mold, and obtaining a casting, and are characterized by to consist of a production process which carries out teeming of the 1380-1440-degree C molten metal to metal mold made from a copper alloy held at temperature of 80-300 degrees C, and obtains a casting, and a production process which performs heat-treatment heated at temperature of 900-940 degrees C in an obtained casting for 30 to 60 minutes.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention carries out teeming of the molten metal of spheroidal graphite cast iron to metal mold, and relates to the method of casting heat-resistant iron system components, such as an internal combustion engine's exhaust pipe (exhaust manifold).
[0002]
[Description of the Prior Art] An internal combustion engine's exhaust pipe (exhaust manifold) leads the hot exhaust air discharged from the cylinder head to a muffler, and the outstanding thermal resistance and high temperature strength are called for. Then, said exhaust manifold is manufactured by casting conventionally using spheroidal graphite cast iron.
[0003] Said spheroidal graphite cast iron is cast iron which it was obtained, and it **** and the graphite has crystallized spherically in the condition by processing molten iron from a cerium, magnesium, calcium, etc. Since said spheroidal graphite cast iron is excellent in a mechanical property and excellent in especially thermal resistance and high temperature strength when the graphite is spheroidizing, it fits the components with which thermal resistance, such as said exhaust manifold, is called for. Casting using said spheroidal graphite cast iron is usually performed by carrying out teeming of the molten metal to a sand mold.
[0004] However, since said molten metal will be annealed if a sand mold is used, said nodular graphite makes it big and rough, and there is un-arranging, that the further excellent high temperature strength is hard to be obtained.
[0005]
[Problem(s) to be Solved by the Invention] This invention cancels this un-arranging and aims at offering the method of casting heat-resistant iron system components equipped with the high temperature strength which was excellent using spheroidal graphite cast iron.
[0006]
[Means for Solving the Problem] It is characterized by to consist of a production process which is the metal-mold-casting method of heat-resistant iron system components of this invention carrying out teeming of the molten metal of spheroidal graphite cast iron to metal mold, and obtaining a casting, carries out teeming of the 1380-1440-degree C molten metal to metal mold made from a copper alloy held at temperature of 80-300 degrees C in order to attain this purpose, and obtains a casting, and a production process which performs heat-treatment heated at temperature of 900-940 degrees C in an obtained casting for 30 to 60 minutes.
[0007] By casting method of this invention, teeming of the 1380-1440-degree C molten metal is first carried out to metal mold made from a copper alloy held at temperature of 80-300 degrees C, and a casting is obtained. When carrying out teeming of the temperature of said molten metal to said metal mold at less than 1380 degrees C, run nature falls. Moreover, when temperature of said molten metal exceeds 1440 degrees C, solidification shrinkage may become large and HIKE may occur in an obtained casting.

[0008] Said metal mold is formed with copper alloys, such as chromium copper. As for temperature of said metal mold, at less than 80 degrees C, if run nature falls and it exceeds 300 degrees C when carrying out teeming of said molten metal, coagulation time will become long, and a detailed organization becomes is hard to be obtained.
[0009] Since speed of metal mold by which said molten metal is cooled as compared with a sand mold is quick when teeming of the molten metal of said spheroidal graphite cast iron is carried out to metal mold on said temperature conditions, nodular graphite to crystallize is made detailed. Consequently, a ferrite of a selection casting becomes precise and improvement in high temperature strength is expected.
[0010] However, if speed by which a molten metal is cooled as mentioned above is quick, although a chill (quenching organization) will occur and a cast degree of hardness will become high, toughness falls and there is a problem that it becomes weak. So, by casting method of this invention next, heat-treatment heated at temperature of 900-940 degrees C in an obtained casting for 30 to 60 minutes is performed.
[0011] By performing said heat-treatment, a cementite (Fe3 C) contained in said chill is decomposed into a ferrite and carbon, and high temperature strength, especially tensile strength become high. A casting with which it was acquired when temperature of said heat-treatment could not decompose a cementite as mentioned above at less than 900 degrees C but it exceeded 940 degrees C oxidizes. Moreover, a casting obtained when time amount heated to said temperature could not decompose a cementite as mentioned above in less than 30 minutes but exceeded 60 minutes oxidizes.
[0012] Consequently, according to a casting method of this invention, as compared with a conventional method using a sand mold, a casting a degree of hardness and whose high temperature strength improved can be obtained.
[0013]
[Embodiment of the Invention] Next, it explains in more detail about the gestalt of operation of this invention, referring to an attached drawing. Drawing 1 is the perspective diagram of the exhaust pipe (exhaust manifold) of the internal combustion engine which is the example of the casting obtained by the casting method of this operation gestalt, drawing 2 is explanatory drawing showing the configuration of the metal mold in which an exhaust manifold is cast, and drawing 3 is a graph which shows change of the tensile strength in the practical use temperature requirement of the casting obtained by the casting method of this operation gestalt, and the casting obtained by the conventional casting method.
[0014] This operation gestalt explains as an example the case where an internal combustion engine's exhaust pipe (exhaust manifold) is cast.
[0015] Like **1** , an exhaust manifold 1 consists of four connections 2 connected to the four cylinder heads (not shown) of this internal combustion engine at each **, and the set section 3 in which each connections 2 gather, when it is an object for the internal combustion engines of a 4-cylinder. Each connection 2 and the set section 3 are hollow, and it is open for free passage inside. Moreover, each connection 2 is connected to the cylinder head through a flange 4, and the set section 3 is connected to a muffler (not shown) through a flange 5. And the hot exhaust air discharged from said cylinder head is led to said muffler through the set section 3 from each connection 2.
[0016] The metal mold used for casting of an exhaust manifold 1 consists of a cover half 11, a sliding nest 12, and an ejector half 13 like the drawing 2 (a) **, and the cavity 15 to which teeming of the molten metal is carried out between cores 14 is formed. A core 14 is a shell core of hollow equipped with the configuration which meets a form among the exhaust manifolds 1 which molding sand is fabricated by the surface through the phenol resin by which coating was carried out, and are shown in drawing 1 with a dashed line. The cavity 15 is equipped with the configuration in alignment with the appearance of the exhaust manifold 1 of **1** .
[0017] The core 14 is being supported and fixed by support pin 16a inserted in a cover half 11, and support pin 16b inserted in the sliding nest 12. 18 is a nest for forming cast hole 18a, and 19 is a gas drainage hole..
[0018] Drawing 2 (b) is drawing which looked at the metal mold of the condition except the ejector half 13 of the drawing 2 (a) ** from the direction which **** to drawing 2 (a). Like the drawing 2 (b) **, the

solid mold 11 is equipped with a socket 19, the gate 20, a runner 21, and the gate 22, and the molten metal by which teeming was carried out from the socket 19 is introduced into a cavity 15 from the gate 22 through the gate 20 and a runner 21. In drawing 2 (b), 23 and 24 are gas drainage holes, and 25 is the filter prepared in the runner 21, and consists of heat-resistant porosity objects, such as a ceramic.
[0019] With this operation gestalt, said metal mold is formed with the copper alloy containing 0.35 - 1.5% of the weight of the chromium of the whole quantity. Said copper alloy may contain 0.1 more or less % of the weight of zinc and an unescapable impurity.
[0020] The exhaust manifold 1 equipped with the configuration of a cavity 15 was cast in this operation gestalt by heating said metal mold at 200 degrees C, and pouring in the molten metal of 1420-degree C spheroidal graphite cast iron from a socket 19. Although cast iron equivalent to FCD450 can be used for said spheroidal graphite cast iron, it can improve thermal resistance by making [more] the content of silicon than FCD450 usual cast iron. The remainder of the presentation of such spheroidal graphite cast iron is iron including 3.3 - 3.7 % of the weight of carbon, 3.4 - 3.8 % of the weight of silicon, 0.5 or less % of the weight of manganese, 0.06 or less % of the weight of Lynn, 0.025 or less % of the weight of sulfur, and 0.005 - 0.025 % of the weight of magnesium to the whole quantity. During said presentation, if the content of magnesium runs short of balling-up of a graphite at less than 0.005 % of the weight and exceeds 0.025 % of the weight, while a shrinkage cavity will occur in a product, it becomes disadvantageous in cost.
[0021] With this operation gestalt, after releasing from mold the exhaust manifold 1 obtained by said casting, heat-treatment heated for 30 minutes at the temperature of 920 degrees C was performed. Consequently, nodular graphite deposited minutely, in connection with this, the organization where a ferrite is also precise was formed and the exhaust manifold 1 whose high temperature strength improved was obtained. The physical properties of the exhaust manifold 1 obtained with this operation gestalt are shown in a table 1.
[0022] Next, the exhaust manifold 1 equipped with the configuration of a cavity 15 was cast by heating the sand mold of the same configuration as said metal mold at 40 degrees C, and pouring in the molten metal of 1380-degree C spheroidal graphite cast iron from a socket 19 for a comparison. Said spheroidal graphite cast iron is the same as that of this operation gestalt.
[0023] And while cooling slowly after casting and within the sand mold, the exhaust manifold 1 was obtained, without performing heat-treatment after mold release. The obtained exhaust manifold 1 had the big and rough diameter of a ferrite as compared with the exhaust manifold 1 obtained with this operation gestalt. The physical properties of the exhaust manifold 1 obtained with the gestalt of this comparison are collectively shown in a table 1.
[0024]
[A table 1]

	引張強度 (kgf/cm², a1400℃)	硬度 (HRB)	変態点 (℃)	フェライト粒径 (μm)
実施形態	38	93	850	0.244
比較の形態	34	88	839	1.59

[0025] As for the exhaust manifold 1 obtained with this operation gestalt, it is clear from a table 1 that the transformation point's made into a heat-resistant use limit to a comparative gestalt by carrying out eburnation of the organization for ferrite particle size by smallness, and the tensile strength and the degree of hardness in 400 degrees C becoming high it is high.
[0026] Next, the result of having measured the tensile strength of the exhaust manifold 1 obtained with this operation gestalt and the comparative gestalt in the 0-800-degree C practical use temperature requirement is shown in drawing 3 . It is clear that the exhaust manifold's 1 obtained from drawing 3 with this operation gestalt tensile strength is high in all the ranges of said operating temperature to a comparative gestalt.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The perspective diagram showing an example of heat-resistant iron system components.
[Drawing 2] Explanatory drawing showing the configuration of the metal mold in which heat-resistant iron system components are cast.
[Drawing 3] The graph which shows change of the tensile strength in the operating temperature range of the casting obtained by the casting method of this invention, and the casting obtained by the conventional casting method.
[Description of Notations]
1 -- Heat-resistant iron system components 11, 12, 13 -- Metal mold made from a copper alloy 14 -- A core, 15 -- Cavity.

[Translation done.]

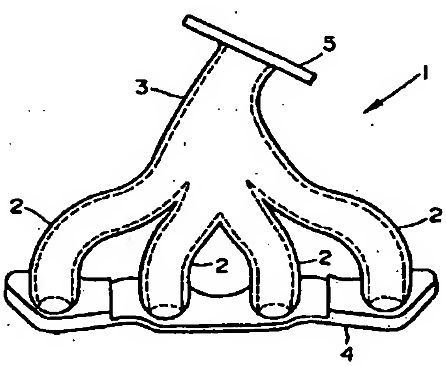
NOTICES

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]

FIG. 1



[Drawing 2]

FIG. 2(a)

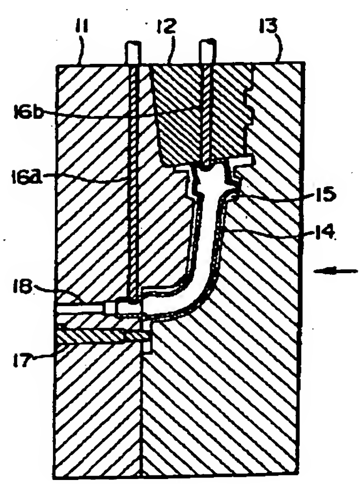
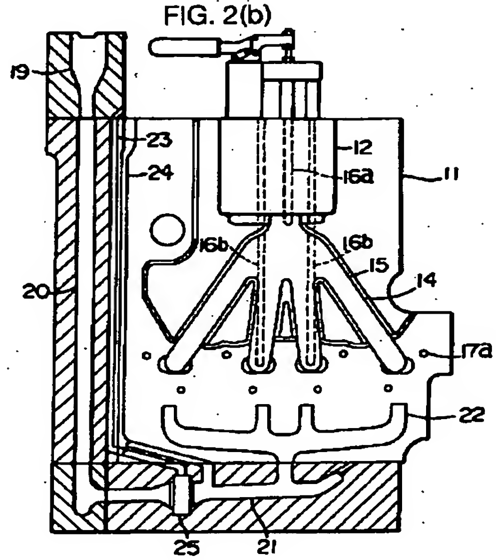
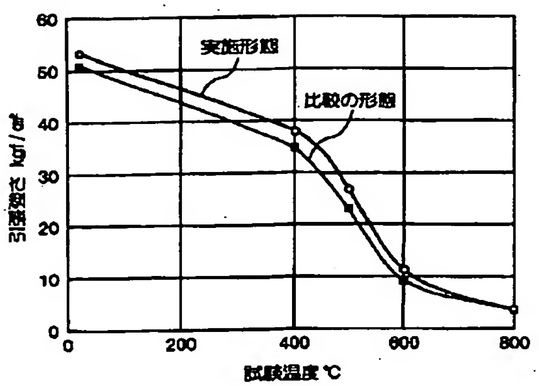


FIG. 2(b)



[Drawing 3]

FIG. 3



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